Noisy Edge Detection through Canny–Deriche Method, SUSAN Edge Detector & Comparison

Evaluator: Dr. Olivier Laligant, *Student: Vamshi Kodipaka*, *Module: AIA/MSCV-2*, *Date: 12-Nov-2019*

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I. Introduction

EDGE Detection is one of the most helpful tool to distinguish sharp & wide changes of luminance in any given image. Gradient approximations are the primitive methods those provided desired results while dealing with noisy images. For highly noised images, image processing scientists have demonstrated different optimal operators by using low-pass filtering with the gradient detector. Some recent developments. Shen and Castan demonstrated a filter with exponential impulse response to detect step edges using a second derivative filter in on a recursive approach. The solutions proved a good resistance to noise and for best localization of contours, but the optimality was not clearly explained. Canny provided analytic expressions for these criteria to give optimized in edges. SNR after detection, localization (L), mean distance between multiple responses of the detector and the real edge multiple response criterion (MRC) are his ideas. By using he described an ideal edge (step edge) has led to the development of an optimal filter defined by its finite impulse response. An unlimited band for spatial application in addition to this criteria was given by Deriche in 1987. To exclude the shorten the filter, Deriche utilized a second-order recursive approach giving better results with the reduction of multiple responses.

II. Methodology

These edge models presented here effectively demonstrate the shape of the edge in the noisy image. Here, my implementation is based on the ideas of the Canny-Deriche's Method and Susan Edge Detectors which provide efficient results on Noisy Images. Then I compared the results obtained from both the methods. Optimization criteria, Filter impulse response, Recursive paramaterization, Suppression non-local maxima are highlights of the first method (Canny-Deriche). Low Level Image Processing of edge detection and structure preserving noise reduction by building edge map are highlights of second method (SUSAN). Create two rectangles. introduce noise in the inner rectangle. Test with Sobel operators, to detect the noise edge which has gave less effective edge results. So I developed below algorithms.

III. Algorithms Developed

Algorithm-1: Canny-Deriche's Method Implementation

1. Input noisy image; in my case : 'noiseimg.JPG'.

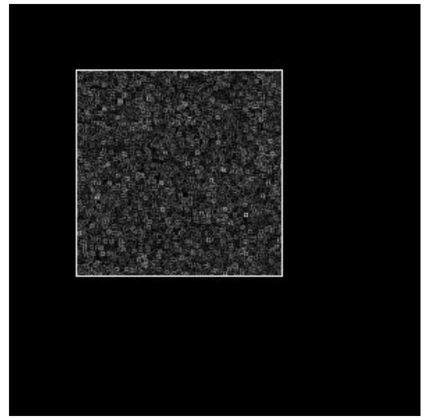


Fig1: Result of the Stage-1 after introducing noise

2. Convert image to gray. Set parameters beta & omegaphi. (I choose: beta = 1; omegaphi = 0.0001)
3. Design the CannyDeriche Filter with these coefficients.

$$z = \frac{1 - 2e^{-\beta} cos\emptyset + e^{-2\beta}}{e^{-\beta} \sin \emptyset}$$

$$k = \frac{\left(1 - 2e^{-\beta} cos\emptyset + e^{-2\beta}\right)(\beta^2 + \emptyset^2)}{(2\beta e^{-\beta} \sin \emptyset + \emptyset - \emptyset e^{-2\beta})}$$

find the other nine coefficients for the CD-filter.
4. Make f(x) and h(x) functions. Find impulse responses.
5. Perform convolution and observe the smoothed image.

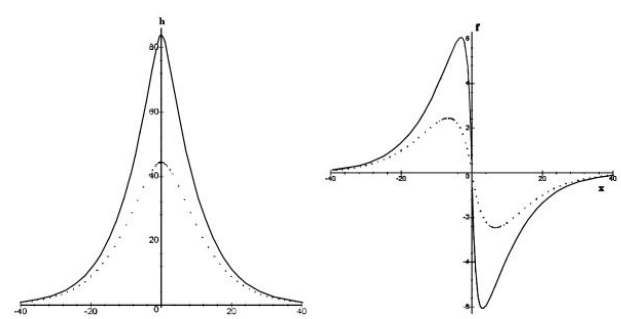
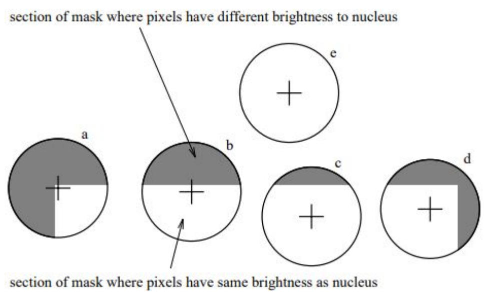


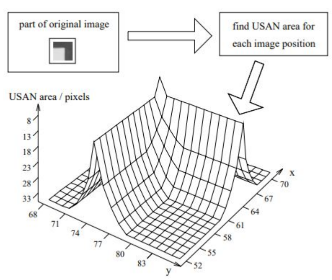
Fig2: Left fig. shows the filter performance and right fig. shows the edge obtained.
6. Then find 'gradX' & 'gradY'
7. With Smoothed gradients estimate magnitude and direction
8. Perform Suppression of local non-maxima (norm-gradient)
9. This step gives no.of parameters in directions/orientations
10. Threshold by hysteresis: Set max and min values

11. Obtain the optimal edge for the given image with noise suppression

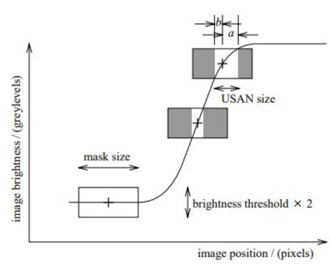
Algorithm-2: Susan Edge Detector Implementation
1. Again Input noisy image; in my case : 'noiseimg.JPG'.
2. Set Brightness Limit & Susan Filter Radius



3. Fit the normalized range of Edge, optimization limit. Usually [0,1] or [0,255]
4. Build Edge map now using the set parameters



5. If input is color image transform to gray scale image
6. Use the circular mask of susan over the noisy region
7. Adjust the geometric limit parameter to initialize padding.



8. Find Susan area and optimize it with edge strength
9. Observe the susan normalized angle has range (0,pi]

IV. Results Obtained

Results obtained for Canny-Deriche's implementation are stated below:

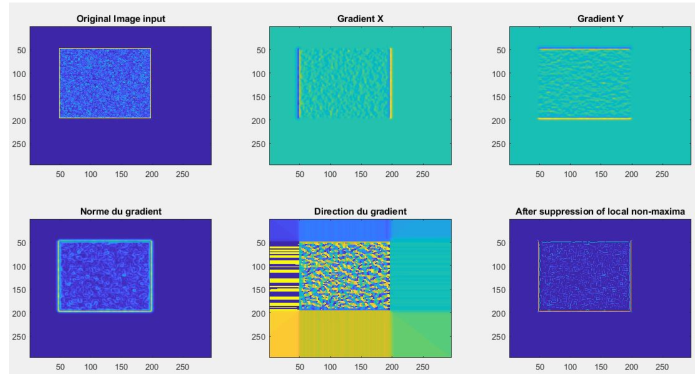


Fig3: Gradient maps of the image before convolution

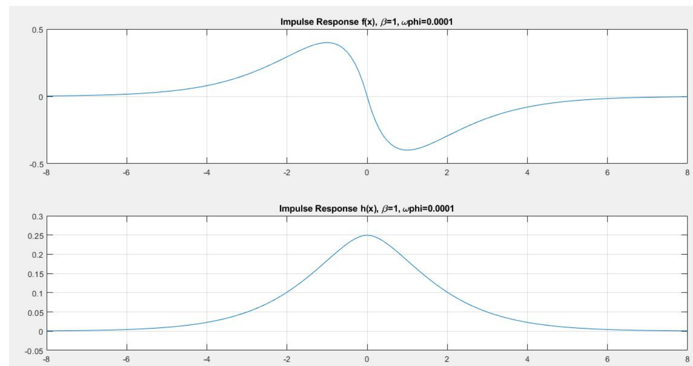


Fig4: Impulse response variation interms of magnitude and direction of gradient output w.r.t beta and omegaphi

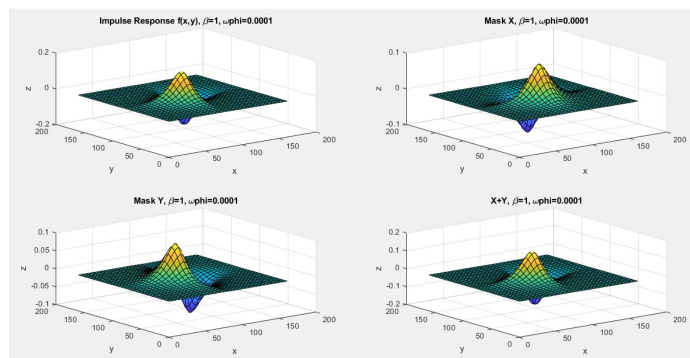


Fig5: Gradient of the image after convolution

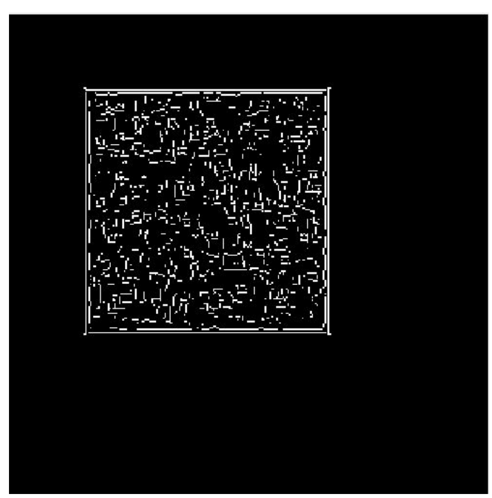


Fig6: Final Canny-Deriche's Edge Output on the rectangle

Results obtained for SUSAN implementation are stated below:

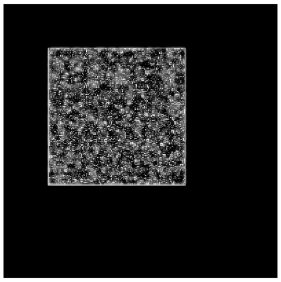


Fig7: Susan's Edge Output on the rectangle

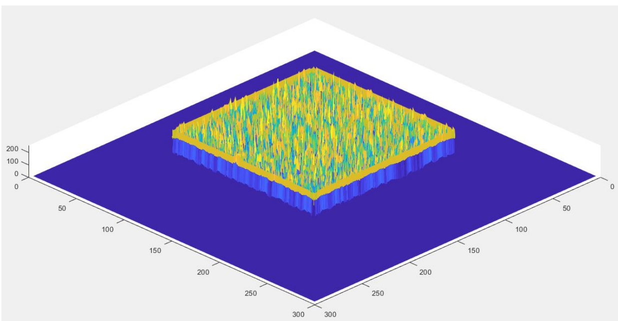


Fig8: 3D Final Susan's Edge Output-Noise variations

V. COMPARISON

Canny-Deriche Convoultion Based Edge Detection On Noisy Images is effective due to the fact that it is treated first with filtering and then we find gradients, in whose performance is incrementally high in finding optimal edges(especially for the regular objects in the noisy image). Now, in Susan Edge case, the image is treated with mask based on intensity variations in finding border strengths.

Processing time for Imp-1: 3.42 sec
Processing time for Imp-2: 1.141 sec

Even the computational time in case-1 is high for larger images; it is efficient to exponential noise edges. Wherein case-2 computational time more and works for smaller noisy image sizes only. It is obvious that its output is much effective compared to Sobel operators based Edges.

VI. CONCLUSION

This paper allows to understand and adopt the two above explained algorithms. Enabling to use the gradient approach on noisy image concerned to set factors. Then, we choose a model that analytically describes the type of noise and intensty present in image constitute of object representations. In order to assists local noise variations adaptive based filtering with sharpened edge detectors are used to compensate the identities of object. However, results obtained by this methods are considered as best by researchers in the image processing applications.

VII. REFERENCES

1. ”Generalization of Canny–Deriche Filter for detection of noisy exponential edge” - F. Truchete, Le2i, UB

2. ”Using Canny's Criteria to Derive a Recursively Implemented Optimal Edge Detector” - Rachid Deriche, Inria

3. ”SUSAN - A New Approach to Low Level Image Processing” - S.M. Smith, Oxford University